

COMETS, HISTORICAL RECORDS AND VEDIC LITERATURE

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A verse in book one of Rigveda mentions a cosmic tree with rope-like aerial roots held up in the sky. Such an imagery might have ensued from the appearance of a comet having ‘tree stem’ like tail, with branched out portions resembling aerial roots. Interestingly enough, a comet referred to as ‘heavenly tree’ was seen in 162 BC, as reported by old Chinese records. Because of weak surface gravity, cometary appendages may possibly assume strange shapes depending on factors like rotation, structure and composition of the comet as well as solar wind pattern. Varahamihira and Ballala Sena listed several comets having strange forms as reported originally by ancient seers such as Parashara, Vriddha Garga, Narada and Garga.

Mahabharata speaks of a mortal king Nahusha who ruled the heavens when Indra, king of gods, went into hiding. Nahusha became luminous and egoistic after absorbing radiance from gods and seers. When he kicked Agastya (southern star Canopus), the latter cursed him to become a serpent and fall from the sky. We posit arguments to surmise that this Mahabharata lore is a mythical recounting of a cometary event wherein a comet crossed Ursa Major, moved southwards with an elongated tail in the direction of Canopus and eventually went out of sight. In order to check whether such a conjecture holds water, a preliminary list of comets (that could have or did come close to Canopus) drawn from various historical records is presented and discussed.

I. INTRODUCTION

Stars and constellations were observed with keen interest by Indo-Aryans, mainly for ascertaining auspicious times to perform various vedic rituals and sacrifices by frequently monitoring apparent stellar motions (Pingree, 1981). It is, therefore, inconceivable that comets of antiquity visible to naked-eye would have escaped attention of vedic seers. After all, bright comets approach the Sun roughly once every five years (Hasegawa, 1980; Ho 1962). However, studies on ancient comets in traditional astronomy of India is handicapped by the fact that, unlike the existing systematic astronomical records of the Greeks and the Chinese describing pre-telescope era comets (Fotheringham, 1919; Ho, 1962; Pingre, 1783; Williams, 2014), ancient Sanskrit texts on cometary events have been lost in the ravages of time.

Because of the absence of older historical records, cometary references often get mingled with myths and lore, making it difficult to establish firmly any inference on comets of antiquity in the Indian context. Varahamihira’s *Brhat Samhita* (BS) of 550 AD cite many older literature on comets attributed to ancient seers like Parashara, Garga, Vriddha Garga and Narada, that are no longer extant (Bhat, 1981). In order to salvage some accounts of comets that might have been sighted from India in ancient times, one is forced to fall back on commentaries provided in BS (Kochhar, 2010) and in Ballala Sena’s *Adbhuta Sagara* (Iyengar, 2008; 2010).

Halley’s own work shows that study of historical records of comets is very important for astronomy. This is evident from extant medieval cometary records of 1337-1698 CE that enabled Halley to characterize orbits of 24 comets (Halley, 1705). This was followed up with estimation of orbital parameters of various comets using data gleaned from old Chinese and European sources (Hasegawa, 1979; Hasegawa, 1980; Ho, 1962; Kiang, 1972; Pingre, 1783). Comets and novae observed by Koreans in the bygone era were collected by Sekiguchi (1917a,b). Similarly, Kanda (1935, 1947) put together old Japanese records of astronomical significance and published them. A large collection of Chinese records, along with Japanese and Korean ones, of past comets and novae were compiled and translated into English by Ho (1962). Kiang (1972) made use of these records to compute orbital trajectory of Halley’s comet over past 28 revolutions, going all the way back to 239 BC. Later, Yeomans and Kiang (1981) retraced the comet’s trajectory to 1404 BC by numerically integrating the equations of motion. In an exciting development, evidence of Halley’s comet sightings in 164 BC and in 87 BC were discovered in Babylonian clay tablets (Stephenson, Yau and Hunger, 1985) referred to as ‘regular watchings’ or Diaries, containing daily observations of the sky that were likely to have been commissioned by priests of Marduk temple (Brown, 2002; Sachs, 1974). Several ancient Assyrian and Babylonian scholars had commented on a comet that appeared late in 675 BC which is yet to be identified (Brown, 2002).

In what follows, we provide a brief discussion on comets in the context of vedic literature in section 2. Section 3 gives a short account of the Nahusha lore and surmises that this is a mythical retelling of a cometary event. Arguments are put forward in support of the conjecture, shortly thereafter. A preliminary study is undertaken in section 4 mainly to shortlist and discuss comets described in historical records that either appeared near Canopus or could have been seen near it. Finally, in section 5, we conclude by reflecting on the possible allusions to comets in vedic texts.

II. DHUMAKETU AND KETU

The Sanskrit word dhumaketu literally means ‘smoke banner’ and it appears in about half a dozen hymns of Rigveda, while Atharvaveda has a hymn about Saptarishi (Ursa Major) being veiled by a dhumaketu, entailing that this word connoted a comet (Iyengar, 2010) more than 3000 years ago. It is to be noted that the mantra portions of Atharvaveda have been dated to about 1150 BC because of their first direct mention of metal iron (Witzel, 1995). Ketus (in plural), meaning rays of light or fire-smoke combine, have also been discussed in Atharvaveda, and it is very likely that they represented comets or meteors (Kochhar, 2010).

Book one of Rigveda has two hymns (1,24,7) and (1,24,8) which have been translated by Griffith (1896) as follows:

7. Varuna, King, of hallowed might, sustaineth erect the Tree’s stem in the baseless region. Its rays, whose root is high above, stream downward. Deep may they sink within us, and be hidden.

8. King Varuna hath made a spacious pathway, a pathway for the Sun wherein to travel. Where no way was he made him set his footstep, and warned afar whate’er afflicts the spirit.

According to Parpola (2009, 2010), these verses were composed around 1000 BC, and could be interpreted as god Varuna, the guardian of cosmic law, holding up the aerial roots of a cosmic banyan tree in the sky. Imagery of a tree stem up in the sky, with long aerial roots, suggests that the simile was inspired by an apparition of a comet of bygone era possessing a ‘tree stem’ like tail with branched out portions resembling rope-like aerial roots (Das Gupta, 2015). It is noteworthy to point out that Chinese records speak of tianchan (‘heavenly tree’), a comet appearing in the southwest on the evening of February 6 in 162 BC (Ho, 1962). Owing to weak surface gravity, cometary appendages resulting from interaction with solar wind and radiation pressure may assume strange shapes depending on spin, structure and composition of the comet as well as solar wind pattern.

Later texts belonging to Puranas (containing old Hindu royal genealogies as well as mythologies) explain the phenomena of stars and planets going around a fixed Dhruva (Pole star), instead of falling down, by invoking invisible rope like aerial roots growing outwards from the Dhruva and attaching themselves to celestial objects (Parpola, 2010). Again, one may speculate that this imagery owes its origin to a comet of antiquity that had appeared in the vicinity of the Pole star.

Varamihira’s BS, after delineating features of 1000 comets, states that it is impossible to determine the rising and setting of comets from any kind of calculation (Subbarayappa and Sarma,1985). Motion of a comet named Chala Ketu (literally, moving comet) was described vividly by Varahamihira, emphasizing its rise on the west and increase in the tail size as it proceeded towards north, and eventually making contact with Ursa Major (Chandel and Sharma, 1991). Anticipating periodic paths, the seer Narada had stated ‘there is only one comet which comes time and again’, while Bhadrabahu estimated comets to be hundreds in number, each with different period (Sharma, 1986; Chandel and Sharma, 1991).

Parashara (who was likely to have lived around 1000 - 700 BC) had cataloged 101 comets, 26 of which (that included Chala Ketu) were described in great detail (Iyengar, 2006). Seer Garga, belonging to about 100 BC (Kane, 1975; Kochhar, 2010), had listed 77 comets that were characterized by a dark reddish hue, as cited in BS (Bhat, 1981; Kochhar, 2010). It is possible that a descendant of Garga had composed Gargya jyotisha between 1 BC and 1 AD, in which both Rahu and Ketu are included in the list of nine grahas (i.e. ‘grabbers’ or planets in the Indian context), with Ketu representing comets, and not the dismembered torso of Rahu (Yano, 2003). One may recall that Rahu and Ketu (as a proper name) are associated with eclipses (Kochhar, 2010).

In Puranic texts, Rahu is a demon who partook celestial ambrosia in a clandestine way to attain immortality. To punish him, Lord Vishnu hurled his discus at Rahu and severed the head from the torso. The tail like torso was christened Ketu, most likely because ketus (comets) generically have tails (Das Gupta, 2015). Speaking of Lord Vishnu, it is interesting to note that Jayadeva (the 12-th century temple poet of Puri Jagannath temple) had described Kalki, the last avatara of Vishnu, carrying a scimitar that blazes like a comet. Could he have been influenced by Ballala Sena’s commentaries on comets? Ballala Sena was a king of Mithila and Vanga (not far from Puri) who had written a treatise named ‘Adbhuta Sagara’ (Ocean of Wonders) sometime around 1100-1200 AD. Adbhuta Sagara described collections of comets originally due to seers Parashara, Vriddha Garga, Garga, Atharva, Varahamihira and Asitadevala (Iyengar, 2008; 2010).

Several Hindu temples have sculptures on the lintel of their entrance doors representing nava grahas (nine ‘planets’) with Ketu depicted as having an anthropomorphic bust along with a serpentine tail. Atharvaveda-Parishishtha contains verses not only about grahas, nakshatras (lunar mansions), and rahu but also about ketus (comets) classified according to seasons (Miki and Yano, 2010). However, many of its chapters were composed after Greek astrology was introduced in India around 300 AD.

III. CANOPUS, URSA MAJOR AND THE NAHUSHA MYTH

Canopus or Alpha Carinae is a -0.73 magnitude, spectral F0 type supergiant, which is about 200000 times more luminous than Sun, and is located 60-80 pc away from us (Achmad, De Jager and Nieuwenhuijzen, 1991). In the northern hemisphere, Canopus is visible during the winter season from regions south of 37 degree latitude. Agastya, a seer who composed around 27 hymns of Rigveda (Mahadevan, 1986), is associated with Alpha Carinae since about 600 BC (Ghurye, 1977). There is also a hymn in Rigveda likely to be due to Agastya in which Pleiades is mentioned (Das Gupta, 2015). According to the Puranic literature, he was the first vedic Aryan to cross the Vindhya hills to explore the southern regions of India (Abhyankar, 2005). It is interesting to note that the older name of Canopus is Alpha Argus as it is associated with the southern constellation Argo Navis. The root of the word Argo could very well be the Sanskrit word Arka, meaning Sun (Allen, 1963) and also, ray of light.

In India, Ursa Major is called Saptarishi (i.e. seven seers), rishi being a Sanskrit word for sage or seer. However, older vedic literature refers to the Big Bear as 'rikshas', which means bears in archaic Sanskrit. This clearly indicates a common Indo-European origin of the vedic people, as the older connotation of Big Bear for the constellation survived till about 1000 BC or earlier. Later, 'rikshas' might have got substituted by the similar sounding 'rishis' (which has a different meaning altogether) as far as this constellation was concerned. (Stars of Ursa Major had been identified with seven seers of Rigveda by about 900 BC (Ghurye, 1972)).

Mahabharata, which is often referred to as the fifth veda, narrates the strange story of Nahusha, a human king, who took charge as the king of gods when Indra went incognito after killing his arch foe, Vrtra. According to Hildebeitel (1977), Nahusha then turned radiant with 'five hundred lights on his forehead burning' as he drew energy from seers, demons, gods, goblins, etc., and reigned over the sky. In order to seek attention of Indra's consort Sachi, he forced the seven seers of Ursa Major to carry him around in a palanquin. Seer Bhrigu, one of the seven sages, seethed with rage because of this humiliation he was subjected to. He requested Agastya to temporarily substitute him and lend his shoulder to the carriage. As Agastya was quite short in height, the palanquin with Nahusha in it, lost its balance when he took Bhrigu's place as a bearer. Tilting of the carriage infuriated Nahusha so much that he angrily kicked Agastya. An enraged Agastya thereby cursed the king to turn into a serpent and fall from the sky (Hildebeitel, 1977).

There are several features in the above lore that lead one to speculate that a very old cometary event, in which the tailed visitor trespassed Saptarishi constellation from north with its tail gradually increasing in size as it moved southward towards the star Agastya, and eventually went out of sight as it dipped below the horizon, metamorphosed into a mythical story (Das Gupta, 2015). Let us go through the key points one by one.

1. Nahusha is intimately linked with celestial objects since he is a son of the daughter of Svarbhanu, the eclipse causing demon of Rigveda (Griffith, 1896; Kochhar, 2010; Vahia and Subbarayappa, 2011), who later got associated with Rahu and Ketu (Kochhar, 2010).

2. He also belongs to the lunar dynasty with ancestors such as Moon, Mercury and Atri, who is one of the seers/stars of Ursa Major (Hildebeitel 1977).

3. Big Bear is also referred to as cart or 'wain' (Ghurye, 1972; Hildebeitel, 1977) and hence could have become a mythical 'carriage' or a 'palanquin' over the years when the comet sighting story was being propagated.

4. Varahamihira had prescribed worship of Agastya for kings, and had stated categorically that if this southern star is struck by a comet or a meteor there would be famine (verse 22 of BS; Bhat, 1981). An important question is: was he aware of the Nahusha lore?

5. According to many Puranic texts, the eclipse causing demon, Rahu, had a serpentine form with just a head and a tail (Kochhar, 2010), very much like a comet. After the demon had surreptitiously tasted the ambrosia that led to immortality, Rahu was struck by Vishnu's discus as an act of retribution (Das Gupta, 2015). Its severed tail was christened as Ketu, a proper noun inspired by the common noun ketu that represents a tailed comet. Hence, it is not a far fetched idea to associate a comet with Nahusha turning into a serpent.

In short, narration of the event wherein a comet traversed across the Big Bear could have created an imagery in the listener's mind in which a radiant object was initially carried by Saptarishi (cart or 'wain'). Then the recounting of comet's motion southwards with its tail growing longer, and eventually making an apparent contact with Canopus before going out of sight, could have conjured up an image of Nahusha kicking Agastya and disappearing from the sky thereafter.

IV. HISTORICAL COMETS AND CANOPUS

An interesting exercise that could be undertaken is to study comets that were observed in the vicinity of Canopus or those which could have been near the southern star so that one may attempt constraining the data set keeping in mind the conjecture of Nahusha myth being a retelling of a past cometary event. In the northern hemisphere, Canopus can clearly be spotted below Sirius during the months of December to March, south of 37 degree latitude.

To make a beginning, we look at reports of comets that came very near the southern star. We also make a preliminary study of far eastern historical records of ancient comets and, in particular, Halley's comet sighted between 240 BC and 530 AD. Although Lao-jen, meaning 'The longevity star' (Canopus), does not seem to be associated with any of the returns of Halley's comet in these records (Stephenson and Yau, 1985), it may still be a worthwhile exercise to list those with perihelion passage times falling during the winter in the period between 240 BC and 530 AD. As it is unlikely that the Nahusha myth was added to Mahabharata post-Varahamihira, we consider its return only up to 530 AD.

A preliminary list of observed comets that came or could have come close to Canopus has been provided below:

1. Comet C/1853 G1 was discovered by K. G. Schweizer on April 5, 1853, south of rho aquilae and which later showed up in the southern hemisphere on April 30, 1853, with its tail pointing towards Canopus. The tail grew from about 4 degree to 8 degree in length within a day and was seen on June 11, 1853 (Kronk, 2003). The estimated period of C/1853 G1 is about 782 years and, therefore, it could have been seen in 493 BC and in 289 AD (Das Gupta, 2015).

2. Similarly, Comet C/1843 D1 was sighted from Wellington, New Zealand, on March 30. It had a tail 36 degree long and its nucleus was 53 deg 41 arc min from Canopus (Orchiston, 2016).

3. As reported by Francis Abbott from Hobart Town, the great comet of 1861 was observed to have a tail 10 degree long and was seen close to Canopus (Abbott, 1861; Orchiston, 1998; Orchiston, 2017).

4. Catalogs due to Ho (1962) and Xu, Pankenier and Jiang (2000) list a very large number of comets that appeared in the winter (of northern hemisphere). Of course, one is aware of the caveat that report of winter apparition does not mean that perihelion passage time fell in winter. In these records, comets are referred to either as stars becoming fuzzy or broom stars or extended vapour or guest star, etc. Lack of space restricts us to list only those winter comets that appeared in the interval from 974 BC to 133 AD:

- (a) A star became fuzzy during February-April in 974 BC
- (b) A broom star appeared in the winter of 525 BC
- (c) During October-December months stars became fuzzy in 482 BC and in 481 BC
- (d) In 238 BC, a broom star appeared in north and moved southwards for 80 days
- (e) A broom star appeared in the east during February 19-March 20 in 234 BC
- (f) 'Heavenly tree' or a comet appeared in the southwest on February 6, 162 BC
- (g) A star in the southwest became fuzzy during January 18 to February 16 in 154 BC
- (h) Between October 12 and November 10, a star became fuzzy in 147 BC
- (i) A star became fuzzy during February-April in 120 BC
- (j) During February-April in 119 BC a star turned fuzzy
- (k) In 69 BC, a star in the west became fuzzy during January 27-February 24
- (l) A star turned fuzzy in 32 BC between February 6 and March 7
- (m) During January 10-February 7, a streak of white vapour appeared in the southwest extending from the ground to the sky in 5 BC
- (n) In AD 22, between November 13-December 12, a star became fuzzy and moved southeast
- (o) During December 17, 46 AD-January 15, 47 AD, a fuzzy star appeared in south
- (p) Between December 6, 55 AD, and April 6, 56 AD, a comet appeared traveling southwestwards
- (q) In January, 78 AD, a star became fuzzy
- (r) A comet appeared in January, 101 AD
- (s) During January 9-February 6, 110 AD, a broom star appeared in south
- (t) A guest star appeared on January 9, 117 AD, in the west
- (u) In 132 AD, a grayish star appeared on January 29 with vapours in the form of rays
- (v) A comet with a long tail appeared southwest on February 8, 133 AD

5. Halley's comet:

One may safely ignore apparitions of Halley's comet in 240 BC, 87 BC, 141 AD, 218 AD, 295 AD, 451 AD and 530 AD since the corresponding perihelion passage times fell in or after March but before October. That leaves only its

appearances in 164 BC, 12 BC, 66 AD and 374 AD for which the perihelion passage months were November, October, January and February, respectively (Hughes, 1985; Kiang, 1972; Tsu, 1934; Yeomans, Rahe and Freitag, 1986). Past orbits of Halley's comet have been well studied, and so it should not be very difficult to rule out possible proximity to Canopus during its apparitions in 164 BC, 12 BC, 66 AD and 374 AD.

Of course, it is far from clear that any of the above comets listed from 4 to 5 came actually close to Canopus. However, comets 4 (d), 4 (f), 4 (g), 4 (m), 4 (o), 4 (p) and 4 (s) in the above list appear promising as far as the possibility of their being seen near Canopus. It is interesting to note that the Chinese document of Se-ma Ts'ien mentions the apparition of the Standard of Tch'e-yeou in 134 BC, which was a comet that had a serpentine form in the shape of a standard (Chavannes, E., 1899). Its appearance had also been reported by Hipparchus (Fotheringham, 1919). Perhaps it is the same comet (no. 39) listed by Ho (1962) and by Xu, Pankenier and Jiang (2000) that was seen in the east during August 31 to September 29 in 135 BC, stretching across the entire sky.

Comet (no.39) of 135 BC was not sighted in the winter as per the historical records (Ho, 1962). However, if it is identified with the Standard of Tch'e-yeou then it is plausible that it could have crossed the perihelion in or after January and reappeared in 134 BC. Then, it makes sense to short list this comet too, particularly because of its serpentine shape. It is noteworthy to point out that, according to Fotheringham (1919), this comet returned during 120-119 BC. In that case, it could correspond to the winter apparitions 4 (i) and 4 (j), making it a comet with 15 years orbital period. According to Kochhar (2010), date of the closure of Mahabharata is likely to be 100 BC, in which case one may surmise that the apparition of Standard of Tch'e-yeou in 134 BC could have given rise to the Nahusha myth.

V. CONCLUSIONS

While Halley's pioneering work of extracting information on cometary orbits from medieval records proved so useful to astronomy, paving the way for further comet research based on far eastern historical catalogs, one encounters a serious setback in the Indian scenario since ancient Indian records of comets are no longer extant. As a consequence it is difficult to separate real cometary references from myths and lore. Nevertheless, it is important to look for allusions in vedic texts to dhumaketu, ketus as well as strange forms (e.g. serpentine or aerial root-like) in the sky (as vedic priests were enamoured by celestial objects, chiefly for time-keeping purposes) with the hope that something significant on comets turn up.

Mention of a cosmic banyan tree, in a late Rigvedic verse, held up in the sky does entail one to speculate that it was inspired by a comet of antiquity, particularly because there exists a reference in old Chinese records to a 162 BC comet as the 'heavenly tree'. Similarly, the myth in which Nahusha turned into a serpent after kicking Agastya and fell from the sky leads one to surmise that description of a comet that trespassed Ursa Major, moved southwards growing in length, crossed Canopus and went below the horizon turned gradually into a lore as it got passed around. The strongest argument in favour of this interpretation comes from Varahamihira's instruction that kings must worship Canopus (Agastya) and that if a comet strikes this southern star, there will be calamities.

There are 19-th century reports of comets that appeared very close to Canopus. Although, ancient far eastern records of comets do not directly mention comets near Lao-jen (Canopus), reference to comets of older times that either moved southwards or were seen in the south survive. Comet that looks very promising, as far as the Nahusha myth is concerned, is the Standard of Tch'e-yeou which was sighted in 134 BC to have a peculiar serpentine form. If one takes 100 BC to be the epoch of closure of Mahabharata then it is plausible that the Nahusha lore grew out of the apparition of this strange comet. Needless to point out that more work is required in this area and one must also study thoroughly the past trajectory of Halley's comet to check whether it could have appeared very close to Canopus.

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